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RESEARCH

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Prevalence of risk factors for diabetic foot development

Prevalência de fatores de risco para o desenvolvimento de pé diabético

Prevalencia factores de riesgo para el desarrollo pie diabético

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ABSTRACT

Objective: The study's goal has been to identify the prevalence of risk factors for diabetic foot development.

Methods: It was a descriptive study with a quantitative approach, which was carried out with the participation of 71 individuals having type 2 Diabetes Mellitus. All participants were registered in a Basic Health Unit in the Northwestern region of Paraná State. Data were collected through interviews and clinical examination of the feet and analyzed using descriptive statistics. **Results:** The most prevalent risk factors for diabetic foot development were the following: dry skin (78.9%), inadequate footwear use on daily basis (70.4%), foot cracks (60.6%) and presence of callosity (56.3%). The prevalence of foot ulceration risk was 35.2%, with grade 2 abnormalities predominating (33.8%). **Conclusion:** Foot clinical examination should be part of the nursing consultation toward the individual having diabetes. Thus, the early identification of risk factors and subsequent care actions planning may be possible.

Descriptors: Diabetes mellitus, diabetic foot, risk factors, nursing.

RESUMO

Objetivo: Identificar a prevalência de fatores de risco para o desenvolvimento de pé diabético. **Métodos:** Estudo descritivo, com abordagem quantitativa, realizado junto a 71 indivíduos com diabetes mellitus tipo 2 cadastrados em uma Unidade de Saúde da região noroeste do Paraná. Os dados foram coletados por meio de entrevista e exame clínico dos pés e analisados por meio de estatística descritiva.

Resultados: Os fatores de risco mais prevalentes para o desenvolvimento de pé diabético foram: pele ressecada (78,9%), utilização de calçados inadequados diariamente (70,4%), rachadura nos pés (60,6%) e presença de calosidade (56,3%). A prevalência do pé de risco para ulceração foi de 35,2%, predominando alterações grau 2 (33,8%). **Conclusão:** O exame clínico dos pés deve fazer parte da consulta de Enfermagem ao indivíduo com diabetes, para que seja possível a identificação precoce de fatores de risco e posterior planejamento de ações de cuidado.

Descritores: Diabetes Mellitus, Pé Diabético, Fatores de Risco, Enfermagem.

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RESUMEN

Objetivo: Identificar la prevalencia de factores de riesgo para el desarrollo de pie diabético. **Métodos:** Se realizó un estudio descriptivo con un enfoque cuantitativo, realizado con 71 sujetos con diabetes tipo 2 inscritos en una Unidad de Salud de la región noroeste de Paraná. Los datos fueron recolectados a través de entrevistas y el examen clínico del pie y se analizaron mediante estadística descriptiva. **Resultados:** Los factores de riesgo para el desarrollo de pie diabético más prevalentes fueron: piel seca (78,9%), el uso de zapatos inadecuados al día (70,4%), pies (60,6%) y la presencia de grietas callosidades (56,3%). La prevalencia de riesgo de ulceración del pie fue del 35,2%, predominantemente de grado 2 cambios (33,8%). **Conclusión:** El examen clínico de los pies debe ser parte de la consulta de enfermería a la persona con diabetes para que la identificación temprana de los factores de riesgo y la posterior planificación de las acciones de atención posibles. **Descriptores:** Diabetes Mellitus, Pie Diabético, Factores de Riesgo, Enfermería.

INTRODUCTION

Diabetes Mellitus (DM) is a chronic disease with increasing incidence and prevalence worldwide. This increase is related to epidemiological, demographic transition, and accumulation of risk factors and behaviors, as well as the influence of social and economic determinants.¹ In 2014, World Health Organization (WHO) estimates indicated 422 million adults having DM, which represents approximately four times as many individuals having this disease in 1980 (108 million).²

The DM is classified as follows: Type 1 DM (T1DM) of autoimmune\idiopathic origin; Type 2 DM (T2DM), gestational diabetes and other specific types of DM. In cases where glucose levels remain intermediate between normality and diabetes may be termed pre-diabetes state, and individuals under this condition have a higher probability of developing the disease.¹

T2DM is the most frequent among DM subtypes and accounts for 90% to 95% of the cases. It is characterized by a defect in the action and secretion of insulin, excessive hepatic glucose production and abnormal fat metabolism, which results in a relative deficiency of that hormone.³ It has a strong genetic predisposition, many individuals do not present the classic symptoms and may remain for years without the disease diagnosis.

The process of having the disease as well as the occurrence of complications, both are related to the accumulation of harmful behaviors (smoking, alcoholism, inadequate feeding and sedentary lifestyle) and risk factors (age and presence of other comorbidities such as hypertension, obesity, and dyslipidemia).^{2,3}

It is known that DM causes acute and chronic complications influenced by diagnosis time, intrinsic and extrinsic factors, in addition to failure to perform glycemic control, which increases the risk of premature death. In the world, in 2012, DM was responsible for 1.5 million deaths. In Brazil, only in 2009, 51,828 people died by it, where Paraná State had 3,386 deaths, showing that DM is among the main causes of death in our country.^{1,3} Among DM chronic complications stand out the following: stroke,

kidney failure, blindness, neuropathy and diabetic foot, which is a major cause of limb amputation.⁴

Diabetic foot is a set of lesions that affects the body peripheral areas of a person having DM, resulting in 90% of neuropathy cases. In these individuals, an injury that can be occasioned by a trauma, for example, usually develops into a possible infection and gangrene, which hinders the natural healing process of the organism and may result in limb amputation.⁵

The diabetic foot is a complication of DM that negatively impacts people's life quality,⁵ since it culminates with changes in daily routine, withdrawal from the work environment, reduction of self-esteem and even on the appearance of other comorbidities such as depression.⁶ In this context, a study carried out with nine patients who had already suffered amputation due to diabetic foot injury at a surgical clinic in *Feira de Santana* city, *Bahia* State, indicated feelings of sadness and sorrow manifested by the interviewees, by the fact that there was a delay in the recognition of risk factors for ulceration and treatment initiation.⁶

Given the risk factors and behaviors, including inadequate foot care habits, it is important that the foot examination should be included in the routine care of individuals having DM by the health professional. Thus, the professional can identify the risk of ulceration in its early stage, and then together with the individual build a care plan in order to prevent the occurrence of injuries that originate the diabetic foot.³

The professional, after examining the individual's feet, should reinforce some basic care related to self-care with the foot, such as the need for daily inspection by the individual, maintaining proper hygiene, straight nail cutting, use of appropriate footwear, avoiding discomfort, use of moisturizers, not performing immersion of the feet in hot water, as well as, preventing moisture between the fingers since it may cause the appearance of mycoses.⁷

Therefore, recognizing the importance of foot examination as well as early identification of risk factors for ulceration, the present study aims to identify the prevalence of risk factors for diabetic foot development.

METHODS

It was a descriptive study of a quantitative approach carried out with individuals having Type 2 Diabetes Mellitus (T2DM) registered in a Basic Health Unit (BHU) of a municipality located in the Northwest region of *Paraná* State.

The municipality has 15 BHUs and 100% population coverage by the Family Health Strategy teams. Until the last four months of 2015, where 2,286 individuals were registered in the BHUs with a diagnosis of DM. The selected BHU, for convenience, has two Family Health Strategy teams, one of them being the action field of the compulsory supervised internship of the 4th year of the Nursing Graduation Program from the University located in the same municipality, at the time of the research.

To define the study population, the number of individuals aged 40 years or older, and a diagnosis of T2DM were recorded in one of the Family Health Strategy teams (106), an estimate error of 5%, a confidence level of 95%, and a prevalence of 50%, in order to obtain greater variability of the studied event, plus 10% for possible either losses or exclusions, resulting in a sample of 84 individuals. The inclusion criteria were both sexes and age equal to or greater than 40 years old. The exclusion criteria were as follows: presenting sequels that impair the communication and diagnosis of some mental illness. After the sample calculation, the participants were randomly drawn from the list with the name and address of individuals having T2DM provided by the team.

The research was carried out by means of a home interview and physical examination of the feet from July to September 2016, by the main researcher and nursing undergraduate students, who were previously trained through five workshops and practical accompaniment by the professor involved in the research during the first three weeks of collection, from Monday to Saturday. To record information regarding lower limb evaluation, including dermatological, circulatory, neuropathic and foot care conditions, an instrument was used based on an earlier study,⁸ as well as information from the Basic Attention Notebook.³

When the individual was not found at home, a new visit had been made on a different day and time. After three attempts to locate, we moved to the next one on the list. The substitution procedure also occurred when the individual randomized presented difficulty or impossibility of verbal communication.

In the evaluation of the lower limbs, the following variables were considered the following: Foot care practices (after dry bathing between the toes, assesses feet, scales feet, walks barefoot, shoes used daily); Foot exams (nails cutting; shoes used at the time of the interview, being considered appropriate the closed model, one centimeter more than the entire internal extension of the shoe, not to be tight nor wide, made of soft leather material or canvas/cotton);⁹ Dermatological alterations (nail and interdigital mycosis, callosity, foot cracks, dry skin, presence of blisters, erythema); Presence of neuropathy (using the Semmes-Weinstein monofilament test of 10 g, because it is an instrument of low cost, easy access and high specificity and predictive value);¹⁰ Orthopedic alterations (presence of hallux valgus, claw toes, hammer toes, and bony prominences), and vascular alteration (palpation of tibia and posterior pedals).

The risk ulceration classification was performed according to the Basic Attention Notebook: Degree 0: absent neuropathy (preserved sensitivity); Grade 1: present neuropathy (sensitivity change); Grade 2: present neuropathy, signs of peripheral vascular disease and/or foot deformity; Grade 3: prior amputation.³

Regarding the analysis, firstly it was performed data input in Microsoft Office Excel 2010 spreadsheets and then transferred to the IBM SPSS version 20 statistical program, in order to perform descriptive analysis by frequency and percentage.

The study was carried out in accordance with the National Council of Health Resolution nº 466/2012, and was approved by the Standing Committee on Ethics in Research Involving Human Beings from the *Universidade Estadual de Maringá* (CAAE: 56119616.0.0000.0104). All the subjects signed the Term of Free and Informed Consent, giving consent to their participation.

RESULTS AND DISCUSSION

There have been evaluated 71 individuals having T2DM, since 13 were not found at home after 3 consecutive home visits, 62% of which were female gender. The age average was 60 years old (minimum: 40 years old, maximum: 77 years old), where 63.4% of the individuals had over 60 years old and 36.6% were in the age group of 40-59 years old. The majority (71.8%) reported having white skin, having a partner (60.6%) and having low schooling (42.3% elementary level and 25.4% school level). The prevalence of elderly individuals with low levels of schooling may have an impact on adherence to treatment and prevention of diseases, especially regarding the understanding of the disease and its complications.¹⁰⁻¹

It is noteworthy that 67.6% had the diagnosis of T2DM over 10 years or more (average diagnosis time of 11 years) and 26.8% used insulin. The family history of T2DM was reported by 69% of respondents and 88.7% reported another associated comorbidity (36.6% systemic arterial hypertension and 22.5% hypertension associated with dyslipidemia).

The diagnosis time of DM and the presence of comorbidities have been pointed out in the literature as factors associated with a greater chance of complications.^{11,2} Although they constitute non-modifiable factors, the importance of nurses in providing guidance on the importance of adherence to drug and non-drug treatment, once they adopt in the daily life of these individuals disease control actions, and also healthy behaviors, acute and chronic complications can be delayed and/or avoided.¹³⁻⁴

Regarding the healthy behavior, food control was reported by 57.7%, physical activity practice by 25.4%, 22.5% were smokers and 9.9% consumed alcoholic beverage above the recommended amount. The literature points out that inadequate eating habits associated with non-adherence to physical exercise are factors directly related to glycemic decompensating issues,¹⁵ which makes the risk of complications even greater. Consequently, it is of great value for the nursing professional to implement during the nursing consultation and construction of the care plan with the individual having DM, guidelines related to healthy living habits.

The glycemic control was reported by 83.1% (26.8% daily control, 25.4% weekly and 29.6% monthly), and is a protective factor for the appearance of complications related to DM. However, a study carried out in the interior of São Paulo State¹⁶ pointed out that this behavior is not frequent in individuals having DM. It is worth noting that failure to perform glycemic control may be one of the main

factors for the development of neuropathy, which in turn constitutes a predisposing factor to the appearance of foot injuries in individuals having DM.

The nurse plays a fundamental role in the attention to the user having DM, since they are given the integral and holistic care. Among the specific functions are the following: the development of educational actions, the nursing consultation, prioritizing the educational approach and the examination of the lower limbs to identify a foot under risk, then supporting the importance of this professional in the prevention of diabetic foot.¹⁶ In this sense, evaluating and monitoring the foot care behaviors of individuals having DM is of great importance for injury prevention.

The diabetic foot brings as one of the main consequences the limb amputation, a procedure that generates high hospital costs and drugs for the health sector besides physical and psychosocial burnout for the individual and his family. In this sense, it is understood that the knowledge of the factors that contribute either directly or indirectly to the development of foot injuries, as well as of the preventive actions that can be adopted, reflect in the reduction of the prevalence of the injuries and, consequently, of the amputations. It also impacts on the high hospital and medical costs for the health sector, as well as physical and psychosocial burnout for the individual and his family.¹¹ The **Table 1** shows the foot care practices performed by the participants.

Table 1 - Foot care practices performed by the individuals having T2DM registered in a Basic Health Unit in the Northwestern region of *Paraná* State, 2016

Variables	Individuals (n = 71)	
	n	%
Dries between the fingers		
Daily	42	59
Never	22	31
Some times	7	9.9
Performs foot care		
Daily	31	43.7
Never	17	23.9
Some times	23	32.4
Performs foot scald		
Daily	2	2.8
Never	42	59.2
Some times	27	38
Walks barefoot		
Daily	5	7
Never	45	63.4
Some times	21	29.6
Uses footwear daily		
Adequate	21	29.6
Inadequate	50	70.4

Variables	Individuals (n = 71)	
	n	%
Nails cutting		
Adequate	24	33.8
Partially Inadequate	21	29.6
Inadequate	26	36.6
Using footwear at the interview time		
Adequate	20	28.2
Inadequate	51	71.8
Hygiene		
Adequate	58	81.7
Inadequate	13	18.3

More than half of the subjects reported drying the interdigital spaces daily. This result was lower than that found in a study carried out with 52 patients, where 96.15% of the individuals performed the daily drying of the interdigital spaces.¹⁷ It is important to note how favorable is this behavior, since the interdigital moisture can favor the mycosis development that is a risk factor for diabetic foot development.¹⁸

Evaluating the feet daily should be part of the routine of the individual having DM since the presence of changes in sensitivity makes it difficult for them to perceive injuries. However, in order to adhere to this behavior, they need to know the importance of this habit. A study carried out with 20 patients from a surgical clinic and an university hospital found that only 20% inspected their feet daily.¹⁹ Thus, during the nursing consultation, in addition to evaluating the feet, it is necessary to offer guidelines regarding the prevention of injuries, which rapidly can evolve to the development of a larger complication such as diabetic foot, although initially it was unnoticeable.²⁰

The practice of foot scalding, although not prevalent among the participants of the present study, is still adopted by some individuals, as pointed out by a study that evaluated the clinical conditions of the feet of individuals having DM.¹⁷ This practice is inadequate, since the feet are the more affected by burns due to loss of sensation by peripheral neuropathy.²⁰ Therefore, it is important to educate the individuals about the risks of this practice.

Avoiding walking barefoot and also wearing proper shoes are important behaviors for foot protection regarding the injury onset. The majority of the participants were using inappropriate shoes at the interviewing time. It is worth mentioning that the use of these shoes predisposes feet to traumas and contribute to the development of foot ulcerations in up to 85% of the cases.⁵ A study of 20 patients found that only 5% used footwear for patients having DM, where the others reported non-acquisition due to the high footwear cost.²¹ In this sense, it is of great value during either educational activities or individual nursing consultation that the professional may be able to provide guidelines regarding the types of shoes routinely used and

offering alternatives to the individuals, always keeping in mind that not everyone is able to achieve the ideal.

Another behavior that requires professional attention during the feet exam is the nails cutting. It is important because the inadequate nails cut favors that the nail imbues, which consequently leads to the appearance of lesions.⁸ In the present study, although the prevalence of inadequate cutting has been lower than that found in a study conducted in *Curitiba* city, which pointed out that 47.5% of the individuals having irregular nails cut, reinforces the importance of this orientation to be included in the follow-up routine of these individuals.²²

In general, the interviewees presented a high prevalence of dermatological alterations in their feet, as shown in the **Table 2**.

Table 2 - Dermatological alterations shown by the individuals having T2DM registered in a Basic Health Unit in the Northwestern region of *Paraná* State, 2016.

Variables	Individuals	
	(n = 71)	
	n	%
Nail mycosis		
Yes	37	52.1
No	34	47.9
Interdigital mycosis		
Yes	13	18.3
No	58	81.7
Callosity		
Yes	40	56.3
No	31	43.7
Foot cracks		
Yes	43	60.6
No	28	39.4
Dry skin		
Yes	56	78.9
No	15	21.1

Dermatological alterations presented a high prevalence among the participants of the present study, with emphasis on onychomycosis, presence of callosity and dry skin. These changes reinforce the need for guidelines related to the incorporation of adequate habits in the daily life of these individuals in order to avoid future complications.²³ Regarding the presence of callosities, nurses should guide basic care, such as not cutting calluses and avoiding foot-scraping. The health professionals should remove the callosities, then avoiding the use of any other means for self-intervention.

Individuals having DM show involvement of the sensory, motor and autonomic fibers, reducing sweat in the feet, leaving them dry and predisposing them to cracks

and fissures, which increases the risk of injury.²⁵ The foot cracks presence corroborated the results of a study carried out with 51 individuals having DM that showed a prevalence of 33.5%.⁵ The high prevalence of cracking and dry skin indicates the need for attention during the physical examination of the feet, since these factors constitute a gateway to microorganisms and consequently can become a infection focus.¹⁷ Given this results and considering the dermatological alterations together with the orientations, it is important to emphasize that the nursing professional needs to use practical activities during either individual or collective care in order to facilitate the patient's learning, demonstrating the correct way to dry the feet, perform nail cutting and moisturizing the skin.

On the other hand, alteration of foot sensitivity is associated with neuropathy that is a complication of DM, which leads to peripheral nerve dysfunction making the individual susceptible to the development of ulceration.²⁶ It justifies the altered sensitivity of patients having DM due to sensibility deficiency, so, the chances of a trauma are greater. In this context, the evaluation of the feet sensitivity using the 10g monofilament should be part of the nursing consultation routine for individuals having DM. Regarding the frequency of foot examination, it is recommended that all individuals should have their feet examined at least once a year, except in the cases of patients with confirmed risk factors, which should be examined every six months.³

Once the sensitivity has been altered, the care must be doubled and the care plan must be constructed by the health professional together with the patient, considering both the patient particularities and the living conditions. The individual should be aware that sensitivity loss makes him/her more susceptible to the development of diabetic foot. Vascular, orthopedic, and neurological changes were present in less than half of the study participants, as shown in the **Table 3**.

Table 3 - Vascular, orthopedic, and neurological changes presented by the individuals having T2DM registered in a Basic Health Unit in the Northwestern region of *Paraná* State, 2016

Variables	Individuals	
	(n = 71)	
	N	%
Intact sensitivity	46	64.80
Loss of sensitivity	25	35.20
Palpable pedal pulse	48	67.60
Non-palpable pedal pulse	6	8.50
Diminished pedal pulse	17	23.90
Palpable tibial pulse	28	39.40
Non-palpable tibial pulse	16	22.50
Diminished tibial pulse	27	38
Adequate capillary filling	51	71.80
Inadequate capillary filling	20	28.20

The detection of vascular alterations through the inspection and palpation of tibial and pedal pulses is also an indispensable evaluation, since hyperglycemia can bring several complications, and among them is the peripheral vascular disease, which if not accompanied by the nurse, it will possibly develop the diabetic foot by the physiological factors of the organism.²⁷

Among the interviewees, 54.9% had foot deformity and 32.3% had bony prominences. These changes are pointed out in the literature as factors that increase the ulceration risk.⁵ The presence of these alterations should be considered during the physical examination, and the patient should be informed of the specific care since they are non-modifiable factors.

The foot under ulceration risk was present in 35.2% of the participants, which means the loss of sensitivity together with vascular alterations. It was noticed that the population still has a limited knowledge of the alterations and the risk behaviors that favor diabetic foot development. Having that in mind, it is reiterated the need to incorporate specific care actions towards the feet care of individuals having DM. Additionally, the health professional can promote educational actions in groups and in the waiting room of the units aiming to demonstrate the basics of foot care.

CONCLUSION

The most prevalent risk factors in the present study for the development of foot ulceration in individuals with T2DM were the following: inadequate footwear, dry skin, the presence of cracks and callosity in the feet.

Given this result, it is up to the nursing professional from the Family Health Strategy to adopt strategies in order to prevent the diabetic foot development and to avoid larger problems, such as limb amputation. The nursing professional is also responsible for integrating the foot clinical examination of individuals having DM into their nursing consultation routine.

It is worth highlighting that the present study presents as a methodological limitation the use of self-reported data, such as glycemic and food control. Also, it was performed with individuals enrolled in a single Basic Health Unit, which makes it impossible to generalize data and possible inferences to other scenarios.

However, in view of the health complications impact with regard to diabetic foot amputation, it is recommended to replicate this research as an incentive strategy for nurses working in the Primary Health Care, given the importance of foot clinical examination as a routine care practice for individuals having DM.

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